Research Article

BIOMEDICAL Journal of Scientific & Technical Research

ISSN: 2574 -1241

DOI: 10.26717/BJSTR.2024.55.008663

Evaluation of Similarity Between Variables by their Native Values and by Proportional Deviations from their Own Exponential Trendlines (pd) -with pd Calculators, Regressions and Visual Analyses - Examples of CHD Subgroups in Different Periods Between 1951-87

Töysä T*

Licentiate of Medicine, Specialty General Practice, Retired, Student of Eastern Finland, Finland

***Corresponding author:** Töysa T, Licentiate of Medicine, Specialty General Practice, Iisalmi, Finland

ARTICLE INFO

Received: February 12, 2024

Published: February 20, 2024

Citation: Töysä T. Evaluation of Similarity Between Variables by their Native Values and by Proportional Deviations from their Own Exponential Trendlines (pd) -with pd Calculators, Regressions and Visual Analyses - Examples of CHD Subgroups in Different Periods Between 1951-87. Biomed J Sci & Tech Res 55(2)-2024. BJSTR. MS.ID.008663.

ABSTRACT

'Native' data of Finnish coronary heart disease mortality (CHD) of rural (rur) and urban (urb) subgroups available only by 3-year means, 3ym, from period 1951-87, (for calculation: 1952-88) revealed, that male (M) (M.CHD.rur) in period 1952-77 associated positively with smoking, consumption of alcohol and sugar, but negatively with milk fats), oppositely to (female) F.CHD.rur and F.CHD.urb and mainly oppositely with M.CHD.urb and pig microangiopathy (MAP) (mortality). Numerical evaluation was challenging, especially because CHD's showed visual similarities. For explaining such a situation is earlier presented a method using "proportional deviations of parameters from their own exponential trendlines" (pd) between start point (α) and end point (ω). Pd data, as well as 'native' data, are here analyzed through Pearson correlations, regressions and visual charts by three periods 1952-86, 1952-77 and 1963-86 (3ym). A ready calculator is presented for producing pd data.

Results: Periodical Pearson correlations between M.CHD and F.CHD data of middle-aged people in rural regions with 'native' [and pd] data were in 1952-86 +0.22 [+0.91], 1952-77 -0.32 [+0.95] and 1963-86 +0.91 [+0.82]. Periodical means +0.27 [+0.89], SD +0.50 [+0.05].Associations between M.CHD.rur and F.CHD.rur were inverse in period 1952-77, opposite to other periods. 'Native' data showed highest reciprocal association in period 1963-86 (+0.91), pd data in 1952-77 (+0.95).

Summary: Pd data [based on proportional deviations from exponential trendlines between start (α) and end points (ω)], via their Pearson correlations, regressions and visual charts can give a new (?) method to evaluate similarity, especially simultaneousness in variation and possibly "pick up" some details, undetectable by linear regression analysis with native data.

Keywords: Statistical; CHD Subgroups; in 1952-86; Alcohol; Sugar; Tobacco; Milk Fat; Females; Males

Abbreviations: α: The First Year of a Period; B: Column of Years; B.i: Coincidental/Casual Year; CHD: Coronary Heart Disease; C.α: CHD.α: CHD During the First Year of the Period in Concern; Post-fix e: Exponential Trendline, e.g. F.CHD.rur.e.(63-86); F: Female; Value for Exponential Tendline in i: Fe.(CHD.i) = POWER[(10,E$8*(B.i-B.α)]*C.α; (F: female, M: Male; pd: Explained in the Next Chapter (Parameters for pd Calculators); rur: Rural; urb: Urban; V: Variable, in this Article CHD; CHD; ω: The Last Year of a Period

 DOI: 10.26717/BJSTR.2024.55.008663

Summary

Pd data [based on proportional deviations from exponential trendlines between start (α) and end points (ω)], via their Pearson correlations, regressions and visual charts can give a new (?) method to measure similarity especially simultaneousness in variation and possibly "pick up" some details, undetectable by linear regression analysis with native data.

Parameters for pd Calculators

year = yr = i, α≤i≤ ω

Exponential trendline equation for CHD.i:

Fe.(CHD.i) = POWER[(10,E$8*(B.i-B.α)]*C.α

E$8: fixed E8 = [log10(CHD.ω) - log10(CHD.α)]/(ω – α)

B.α: start year: (fixed) B.α = B$10 (for 1952) or B$21 (for 1963)

B,ω = end year: 1986 in period 1 & 2, 1977 in period 2

B.i = (non-fixed year) = B.α ≤ B.i ≤ B.ω. [it is changing by drawing with mouse on column D].

C.α = CHD.α = (fixed) CHD.α = C$10 for 1952 or C$21 for 1963 (values by 3-yer means)

pd.i = proportional deviation from exponential Trend-line point i (in percents) = [CHD.i – Fe.(CHD.i)]/Fe.(CHD.i)*100.

Introduction

Rural male CHD (mortality) (M.CHD.rur) associated highly differently with environmental and behavioral factors to other cardiac mortality subgroups [1,2]. It seemed to need explanation, which is partially given in [3]. The difference was highest in period 1952-77, when M.CHD.rur associated with behavioral (alcohol, tobacco, milk fat and sugar consumption) and environmental (Mg/K and Mg/Ca fertilization) factors oppositely to F.CHD.rur and F.CHD.urb. The opposite statistical behavior of M.CHD.rur was nearly the same with M.CHD.urb and Pig MAP (microangiopathy, autopsy data) [2]. Possible causes are inside each factor: amount of exposure and delay from predisposition to measured signs (mortality in CHD or Pig MAP) and difference in protecting factors or even limitations in linear assessments (e.g. Pearson) for measuring similarity or coherence. The aim of this article is to present a method and a calculator of proportional deviations from their own exponential trendlines (pd), between start point (α) and end point (ω), graphics and numeric data by Pearson correlations, comparing them with Pearson correlations by 'native' data and regressions of variables (by native and pd data).

Materials and Methods

Age adjusted CHD data of middle-aged males and females in rural and urban regions during 1951-87 are attained by ruler from [1], in its fifth figure ("Kuvio"), on a logarithmic scale, by 3-year moving means (3ym). Calculations produce three-year average CHD data for period 1952-86, partially presented in [2,3]. Figure 1. M.CHD.rur and M.CHD.urb, 3ym, from 1951-87. This survey concentrates in three (calculated) periods: 1952-86, 1952-77 and 1963-86. For each period are represented 3ym data, formation of exponential trendline (e) and pd-parameters (labeled "pd" or "3ym.pd") in numbers and figures. Additionally are presented Pearson correlations and regressions of M.CHD.rur by F.CHD.rur (with 'native' (3ym) and (3ym.)pd data). Regressions are calculated by IBM SPSS program. Microsoft Exel is benefited for chart forming.

Exclusion of CHD.urb

Because F.CHD.urb and F.CHD.rur behave nearly similarly (as shown in Figure 2) this survey concentrates in assessment of CHD's in rural regions.

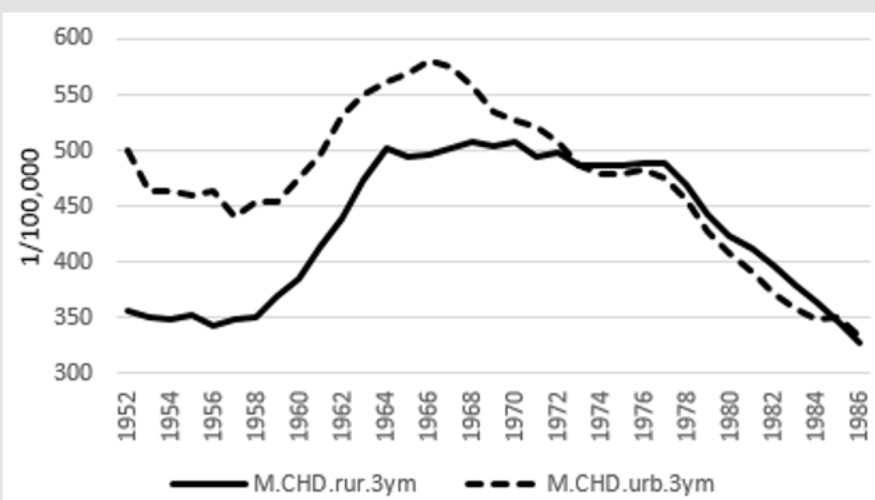

Figure 1: Male CHD mortality in rural and urban regions in 1951-87, 3-year means.

DOI: 10.26717/BJSTR.2024.55.008663

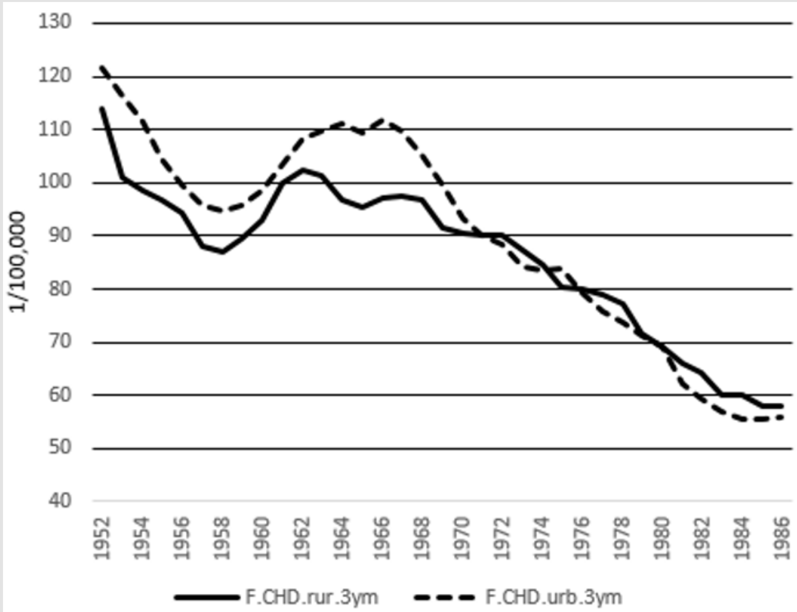

Figure 2: **Female CHD mortality in rural and urban areas 1951-87, 3-year means.**

Results

Period 1952-86 with Calculations and Charts

Figure 3 presents age adjusted male and female CHD mortality of middle-aged people in rural regions from 1951-87 (3-year means, 3ym, are available only for years from 1952 to 1986, which are used for calculations and titles on the following pages). The Figure 3 is replaced here to help to understand the following figures, although it is a part of given materials. Figure 4 shows M.CHD.rur and its proportional exponential trendline [e], between 1952 and 1986. Figure 5 shows F.CHD.rur and its proportional exponential trendline [e] between 1952 and 1986. In Figure 6. M.CHD.rur.3ym.pd shows negative values (i.e. below the trendline) in 1952-58, less than F.CHD.rur.3ym.pd, which shows negatine values in 1952-61 and 1983-86. Figure 7 shows M.CHD.rur.3ym and its regression by F.CHD.rur.3ym in 1952-86, R square 4.6 %, p = 0.215 (SIC!), i.e. non-significant). Positive association (R = +0.215 (SIC!)). Figure 8 shows M.CHD.rur.3ym.pd and its regression by F.CHD.rur.3ym.pd in 1952-86. R square 83 %, (p = 0.000).

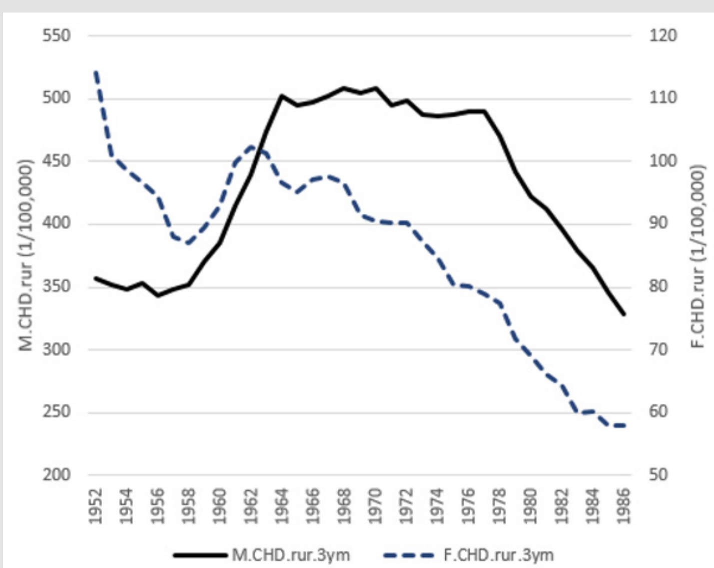

Figure 3: Female and Male CHD.rur, 3-year means, in 1952-86.

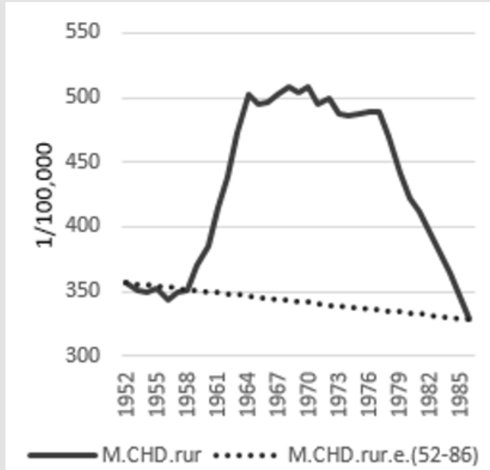

Figure 4: M.CHD.rur and its exponential trendline, α = 1952, ω = 1986.

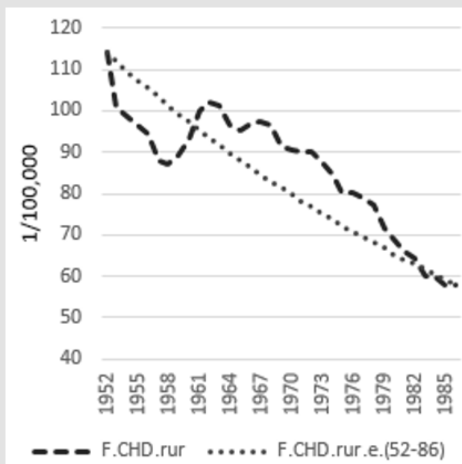

Figure 5: F.CHD.rur and its exponential trendline, α = 1952, ω = 1986.

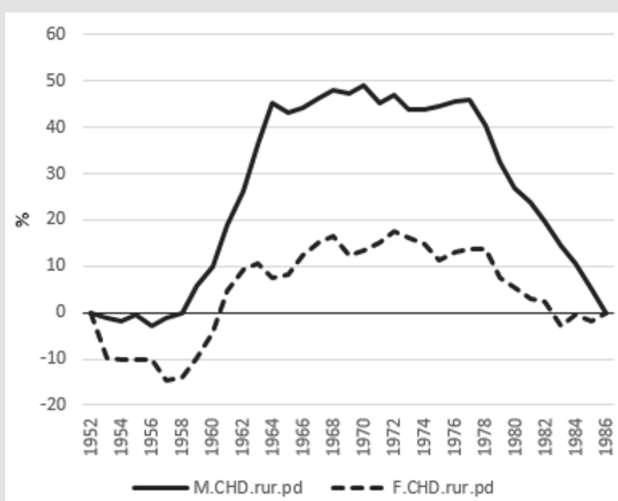

Figure 6: M.CHD.rur.pd and F.CHD.rur.pd between 1952 and 1986.

 DOI: 10.26717/BJSTR.2024.55.008663

Figure 7: M.CHD.rur.3ym and its Regression by F.CHD.rur.3ym in 1952-86.

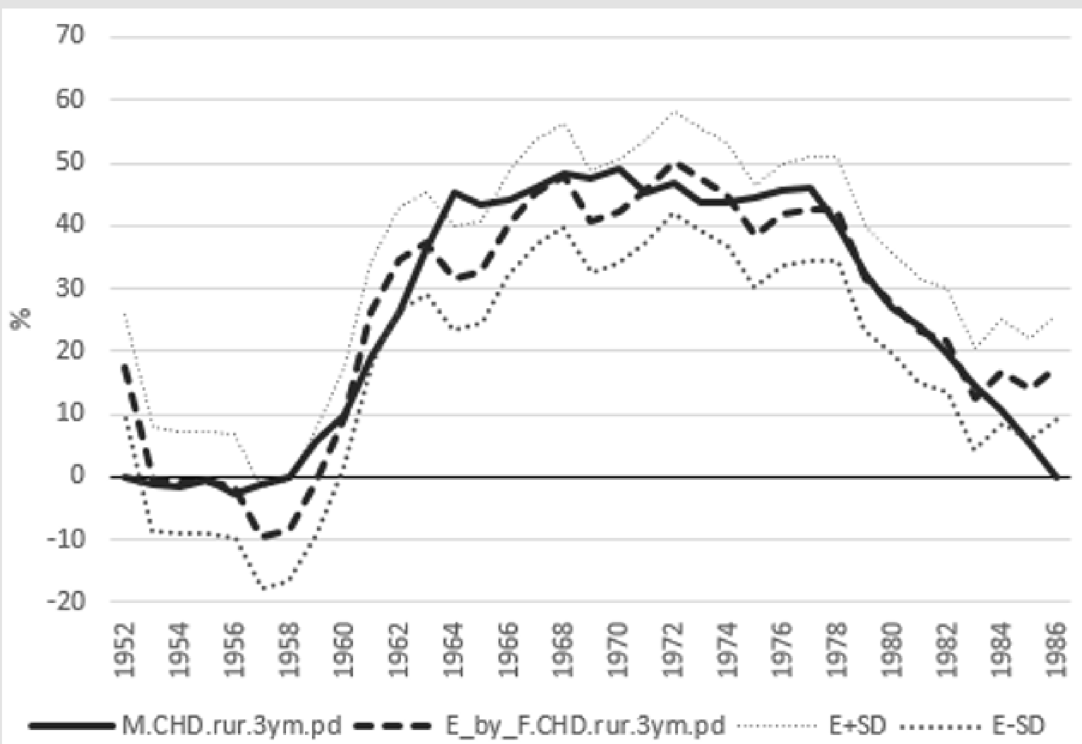

Figure 8: M.CHD.rur. 3ym.pd and its Regression by F.CHD.rur.3ym.pd in 1952-86.

DOI: 10.26717/BJSTR.2024.55.008663

Table 1: M.CHD.rur and F.CHD.rur by three-year moving means, their exponential trendlines (e) between start (α) with and end points (ω) and pd-values (%) from 1951-87.

A	B	C	D	E	A	B	C	D	E
	Trend.(CHD.i) =					Trend.(CHD.i) =			
	POWER(10,E$8*(B.i-B.α))*C.α					POWER(10,E$8*(B.i-B.α))*C.α			
		CHD	yr	log10(CHD)			CHD	yr	log10(CHD)
	α	357	1952	2.55		α	114	1952	2.06
	ω	328	1986	2.52		ω	58	1986	1.76
	Δ.(ω;α)	-28	34	-0.036		Δ.(ω;α)	-56	34	-0.293
8	Δ per yr			-0.0011	8	Δ per yr			-0.0086
		M.CHD.rur	M.CHD.rur.e	M.CHD.rur.pd (%)			F.CHD.rur	F.CHD.rur.e	F.CHD.rur.pd (%)
10	**1952**	**357**	**357**	**0**	**10**	**1952**	**114**	**114**	**0**
	1953	351	356	-1		1953	101	112	-9.7
	1954	349	355	-2		1954	99	110	-10
	1955	353	354	0		1955	97	107	-10
	1956	344	353	-3		1956	94	105	-10.3
	1957	349	352	-1		1957	88	103	-14.8
	1958	351	352	0		1958	87	101	-14.1
	1959	370	351	6		1959	89	99	-9.9
	1960	385	350	10		1960	93	97	-4.4
	1961	415	349	19		1961	100	95	4.6
	1962	439	348	26		1962	102	94	9.3
(21)	1963	473	347	36	(21)	1963	101	92	10.6
	1964	503	346	45		1964	97	90	7.6
	1965	495	346	43		1965	95	88	8.1
	1966	497	345	44		1966	97	86	12.4
	1967	503	344	46		1967	97	85	15.1
	1968	508	343	48		1968	97	83	16.5
	1969	505	342	47		1969	92	81	12.5
	1970	508	341	49		1970	90	80	13.4
	1971	495	341	45		1971	90	78	15.2
	1972	499	340	47		1972	90	77	17.6
	1973	488	339	44		1973	87	75	16.2
	1974	486	338	44		1974	85	74	14.9
	1975	488	337	45		1975	80	72	11.3
	1976	490	336	45		1976	80	71	13.1
(35)	1977	490	336	46	(35)	1977	79	69	13.6
	1978	470	335	40		1978	77	68	13.6
	1979	442	334	32		1979	72	67	7.6
	1980	423	333	27	=	1980	69	65	5.5
	1981	412	332	24		1981	66	64	3.1
	1982	396	332	20		1982	64	63	2.3

DOI: 10.26717/BJSTR.2024.55.008663

	1983	379	331	15		1983	60	62	-2.8
	1984	365	330	11		1984	60	60	-0.4
	1985	346	329	5		1985	58	59	-2
44	1986	328	328	0	44	1986	58	58	0

Period 1952-77 with Calculations and Charts (Table 2)

Figure 9 and Figure 10 show rural CHD mortality (3ym) of both genders between 1952 and 1986 and exponential trendlines [e] with end points (ω) at 1977. Figure 12 Male and female CHD.rur.pd show concurrent negative values between 1952 and 1961, after that mainly positive until 1977. Figure 12 Regression of M.CHD.rur explained F.CHD.rur negatively by 10.3 %, i.e. "worse than by 0 %" (R = -0.32). Figure 13 M.CHD.rur.pd was explained 90.6 % by F.CHD.rur.pd. R = +0.95 (p = 0.000).

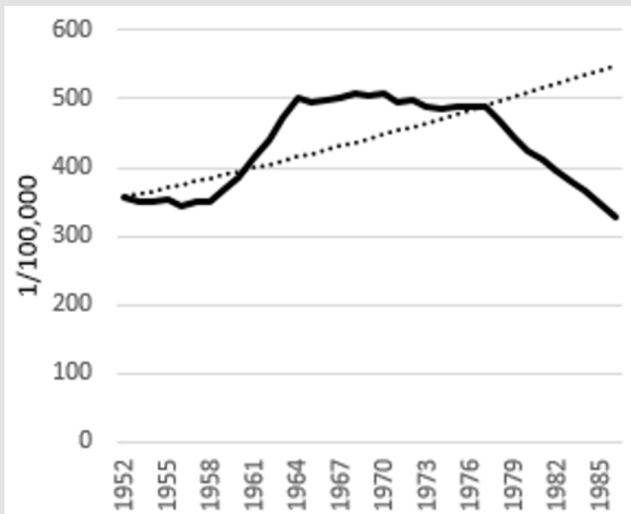

Figure 9: M.CHD.rur and its exponential trendline, α = 1952, ω = 1977.

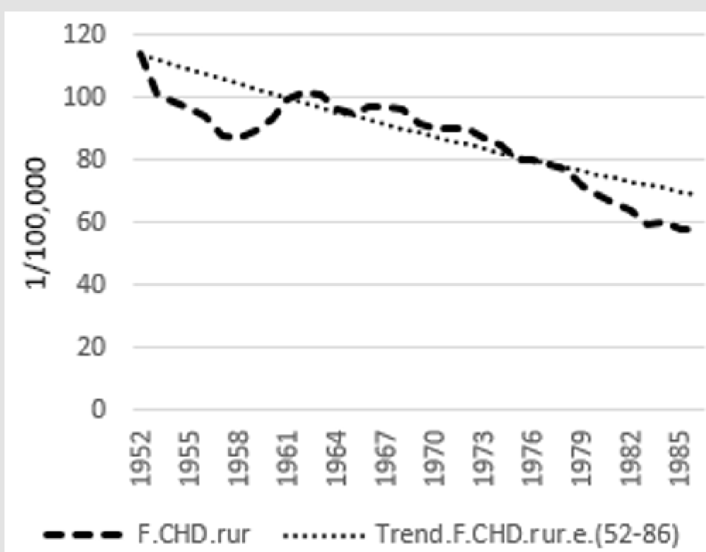

Figure 10: F.CHD.rur and its exponential trendline, α = 1952, ω = 1977.

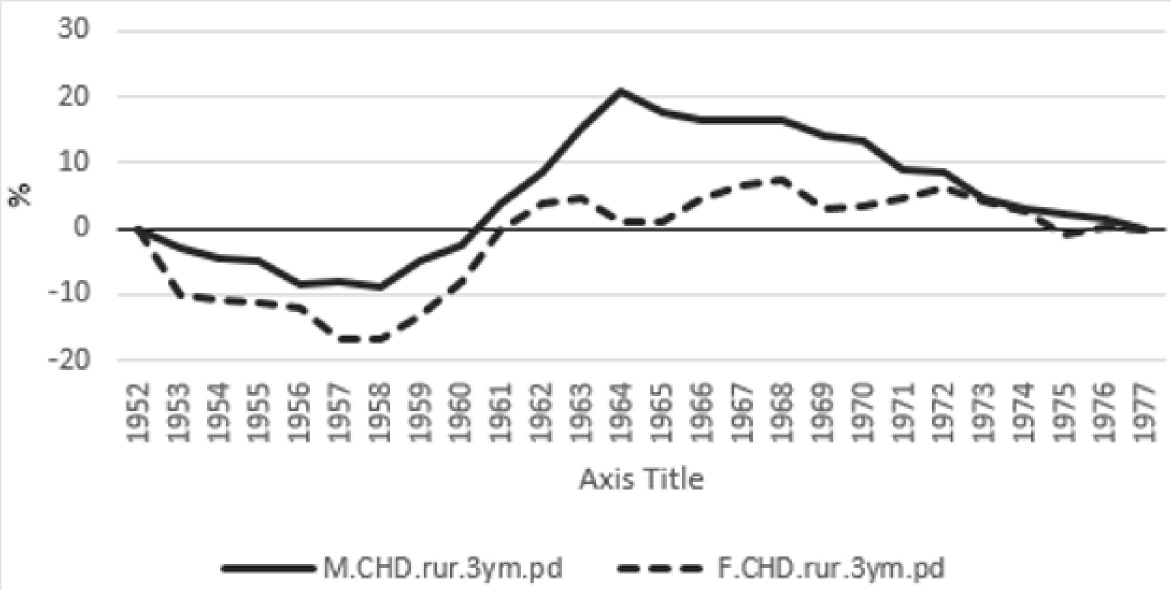

Figure 11: M.CHD.rur.3ym.pd and F.CHD.rur.3ym.pd between 1952 and 1977.

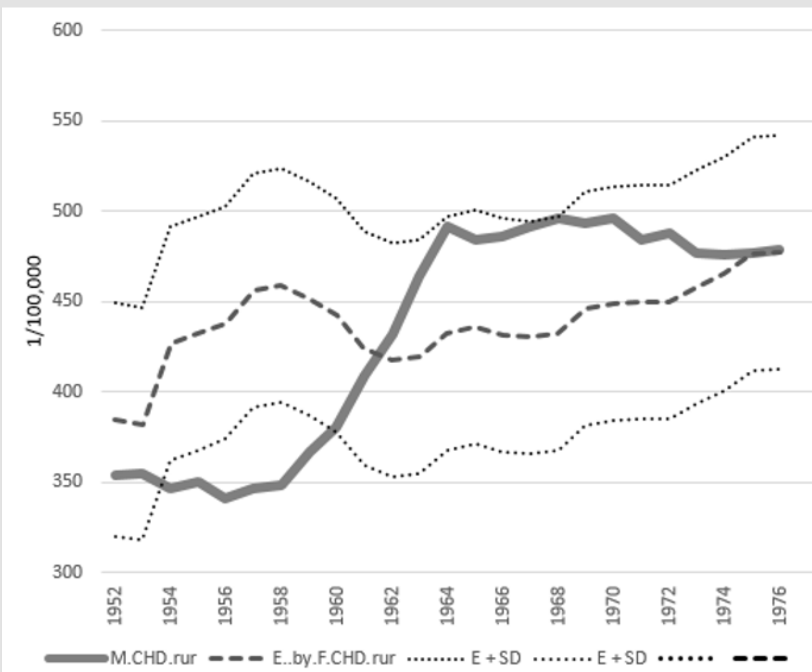

Figure 12: M.CHD.rur.3ym and its Regression by F.CHD.rur in 1952-77.

 DOI: 10.26717/BJSTR.2024.55.008663

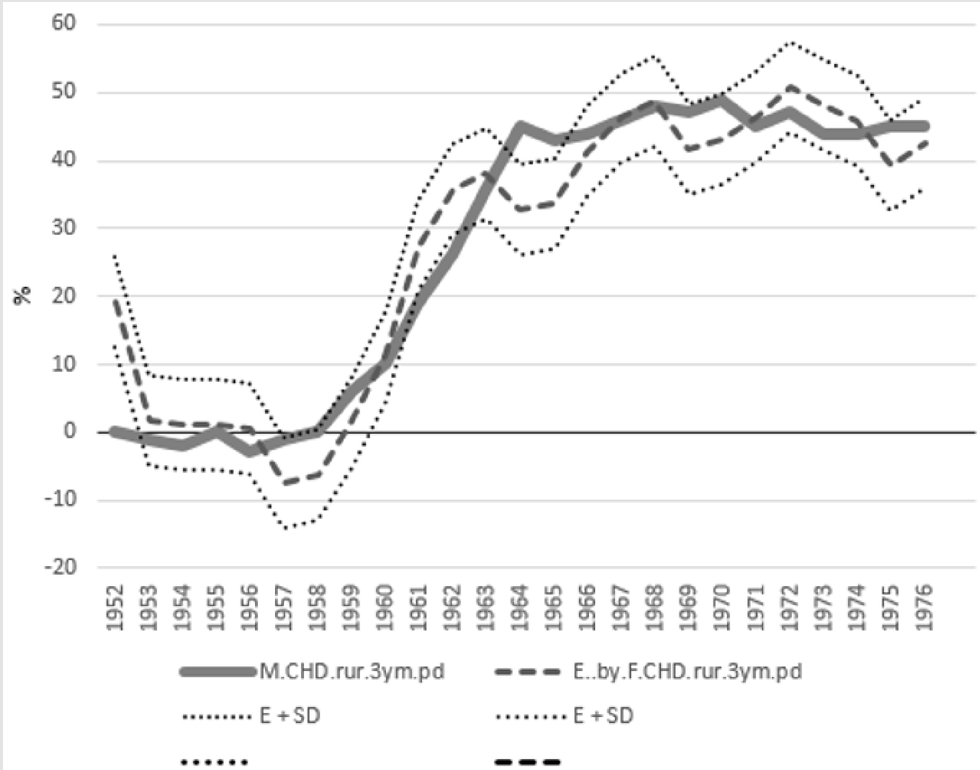

Figure 13: M.CHD.rur.3ym.pd and its Regression by F.CHD.rur.3ym.pd, in 1952-77.

Table 2: CHD mortality in rural regions amongst middle-aged males and females by three-year moving meanstheir exponential trendlines (e) between start and end points (α and ω) and pd's (%) in 1952-77.

A	B	C	D	E	A	B	C	D	E
	Trend.(y.i) =					**Trend.(CHD.i) =**			
	POWER(10,E$8*(B10-B$10))*C$10					**POWER(10,E$8*(B10-B$10))*C$10**			
		CHD	yr	log10(CHD)			CHD	yr	log10(CHD)
	α	357	1952	2.55		α	114	1952	2.06
	ω	490	1977	2.69		ω	79	1977	1.9
	Δ.(ω;α)	133	25	0.137		Δ.(ω;α)	-35	25	-0.16
8	Δ per yr			0.0055	8	Δ per yr			-0.0064
		M.CHD.rur	M.CHD. rur.e.(52-86)	M.CHD.rur.pd (%)			F.CHD.rur	F.CHD.rur.e.(52-86)	F.CHD.rur.pd (%)
10	1952	357	357	0	10	1952	114	114	0
	1953	351	361	-2.7		1953	101	112	-10.1
	1954	349	366	-5		1954	99	111	-10.9
	1955	353	371	-5		1955	97	109	-11.4
	1956	344	375	-8		1956	94	108	-12.1
	1957	349	380	-8		1957	88	106	-16.9
	1958	351	385	-9		1958	87	104	-16.7

 DOI: 10.26717/BJSTR.2024.55.008663

	1959	370	390	-5		1959	89	103	-13.1
	1960	385	395	-3		1960	93	101	-8.2
	1961	415	400	4		1961	100	100	-0.1
	1962	439	405	8		1962	102	98	3.8
(21)	**1963**	**473**	**410**	**15**	**(21)**	**1963**	**101**	**97**	**4.6**
	1964	503	415	21		1964	97	96	1.2
	1965	495	421	18		1965	95	94	1.1
	1966	497	426	17		1966	97	93	4.7
	1967	503	431	17		1967	97	91	6.7
	1968	508	437	16		1968	97	90	7.4
	1969	505	442	14		1969	92	89	3.2
	1970	508	448	13		1970	90	87	3.5
	1971	495	454	9		1971	90	86	4.6
	1972	499	460	9		1972	90	85	6.2
	1973	488	465	5		1973	87	84	4.4
	1974	486	471	3		1974	85	82	2.7
	1975	488	477	2		1975	80	81	-1
	1976	490	483	1		1976	80	80	0.1
(35)	1977	490	490	0	(35)	1977	79	79	0
	1978	470	496	-5		1978	77	78	-0.5
	1979	442	502	-12		1979	72	77	-6.3
	1980	423	509	-17		1980	69	75	-8.5
	1981	412	515	-20		1981	66	74	-11.1
	1982	396	522	-24		1982	64	73	-12.2
	1983	379	528	-28		1983	60	72	-17
	1984	365	535	-32		1984	60	71	-15.4
	1985	346	542	-36		1985	58	70	-17.2
(44)	1986	328	549	-40	(44)	1986	58	69	-15.9

Period 1963-86 with Calculations and Charts (Table 6)

Figure 14 and Figure 15 show rural CHD (3ym) of both genders between 1952-86 with exponential trendlines [e], α = 1963, ω = 1986. Figure 16 shows development of male and female CHD.rur.3ym. Figure 17 shows development of male and female CHD.rur.3ym.pd. Figure 18 shows M.CHD.rur.3ym and its regression by F.CHD.rur.3ym in 1963-86. (R square 82.2 %, p = 0.000). Figure 19 shows M.CHD.rur.3ym.pd and its regression by F.CHD.rur.3ym.pd. (R = +0.82, R square 67.7 %, p= 0.000).

Table 3: CHD mortality in rural regions amongst middle-aged males and females by three-year moving means their exponential trendlines (e) between start and end points (α and ω) and pd's (%) in 1963-86.

A	B	C	D	E	A	B	C	D	E
	Trend.(CHD.i) =					**Trend.(CHD.i) =**			
	POWER(10,E$8*(B.i-B.α))*C.α					**POWER(10,E$8*(B.i-B.α))*C.α**			
		CHD	yrs	log10(CHD)			CHD	yr	log10(CHD)
	α	473	1963	2.68		α	101	1963	2.01
	ω	328	1986	2.52		ω	58	1986	1.76
	Δ.(ω;α)	-145	23	-0.16		Δ.(ω;α)	-145	23	-0.242

 DOI: 10.26717/BJSTR.2024.55.008663

8	Δ per yr	-6.3		-0.0069	8	Δ per yr	-6.3		-0.0105
		M.CHD.rur	M.CHD. rur.e.(63-86)	M.CHD.rur.pd (%)			F.CHD.rur	F.CHD.rur.e.(63-86)	F.CHD.rur.pd (%)
10	1952	357	564	-36.7	10	1952	114	132	-13.8
	1953	351	555	-36.6		1953	101	129	-21.8
	1954	349	546	-36.1		1954	99	126	-21.8
	1955	353	537	-34.4		1955	97	123	-21.4
	1956	344	529	-35		1956	94	120	-21.4
	1957	349	521	-33		1957	88	117	-24.9
	1958	351	512	-31.4		1958	87	114	-24
	1959	370	504	-26.5		1959	89	112	-20
	1960	385	496	-22.5		1960	93	109	-14.7
	1961	415	489	-15.1		1961	100	106	-6.2
	1962	439	481	-8.7		1962	102	104	-1.6
21	**1963**	**473**	**473**	**0**	**21**	**1963**	**101**	**101**	**0**
	1964	503	466	7.9		1964	97	99	-2.3
	1965	495	458	8		1965	95	97	-1.4
	1966	497	451	10.1		1966	97	94	3
	1967	503	444	13.2		1967	97	92	5.9
	1968	508	437	16.3		1968	97	90	7.7
	1969	505	430	17.3		1969	92	88	4.4
	1970	508	423	20.1		1970	90	86	5.7
	1971	495	417	18.8		1971	90	84	7.9
	1972	499	410	21.6		1972	90	82	10.6
	1973	488	404	20.8		1973	87	80	9.8
	1974	486	397	22.3		1974	85	78	9
	1975	488	391	24.7		1975	80	76	6.1
	1976	490	385	27.2		1976	80	74	8.3
35	1977	490	379	29.2	35	1977	79	72	9.2
	1978	470	373	26		1978	77	70	9.7
	1979	442	367	20.5		1979	72	69	4.3
	1980	423	361	17		1980	69	67	2.8
	1981	412	356	15.8		1981	66	66	0.8
	1982	396	350	13.3		1982	64	64	0.5
	1983	379	344	10		1983	60	62	-4
	1984	365	339	7.6		1984	60	61	-1.3
	1985	346	334	3.8		1985	58	59	-2.4
44	1986	328	328	0	44	1986	58	58	0

DOI: 10.26717/BJSTR.2024.55.008663

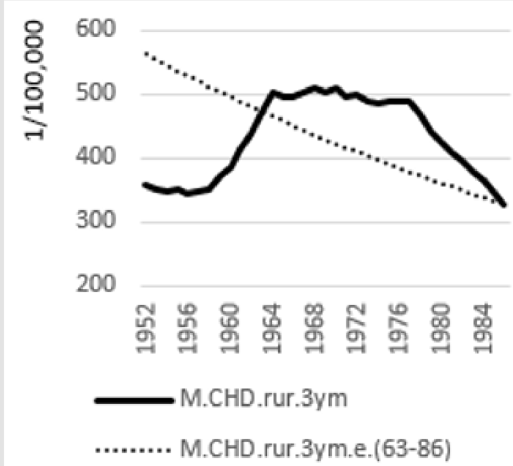

Figure 14: M.CHD.rur.3ym and its exponential trendline, α = 1963, ω = 1986.

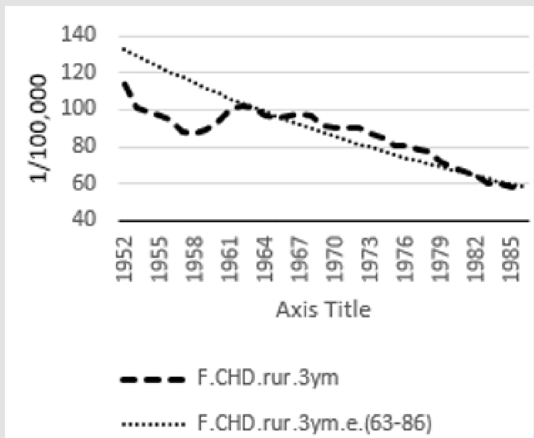

Figure 15: F.CHD.rur.3ym and its exponential trendline, α = 1963, ω = 1986.

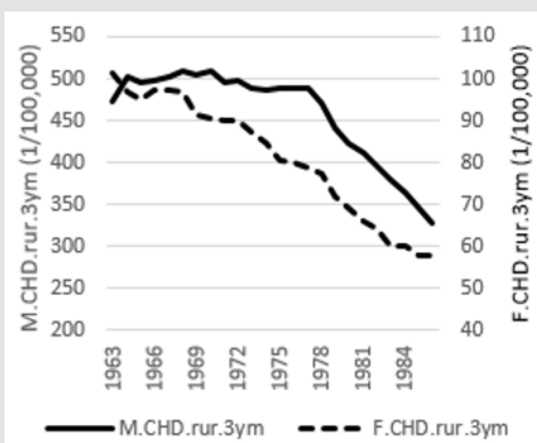

Figure 16: M.CHD.rur and its Trendline 1963-86.

DOI: 10.26717/BJSTR.2024.55.008663

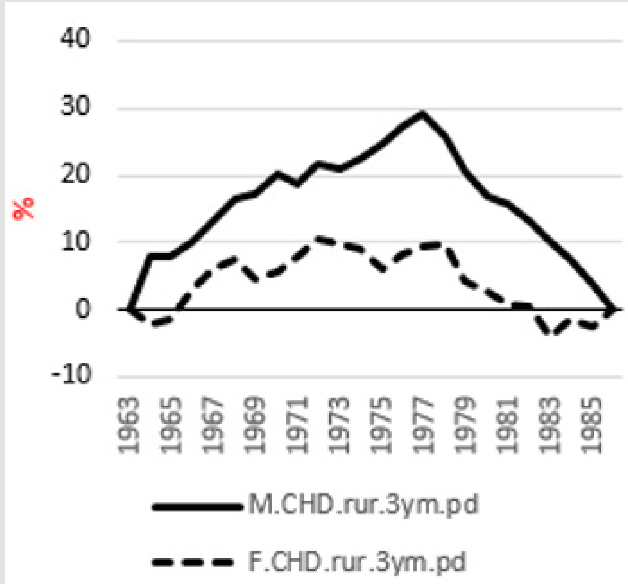

Figure 17: M.CHD.rur.pd and F.CHD.rur.pd in 1963-86.

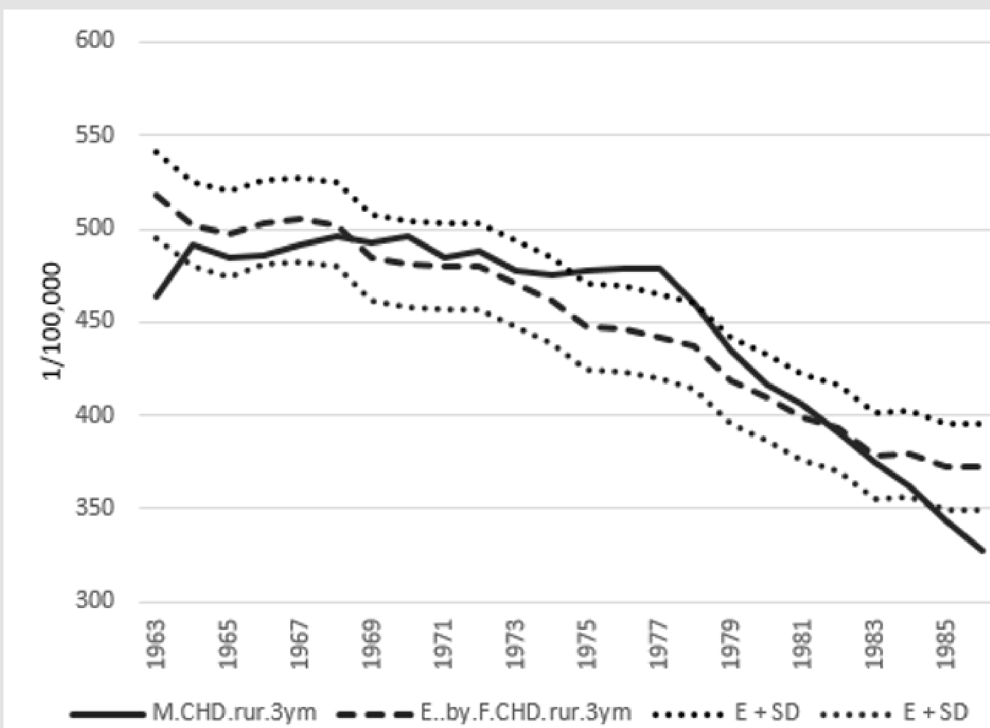

Figure 18: M.CHD.rur.3ym and its regression by F.CHD.rur.3ym in 1963-86.

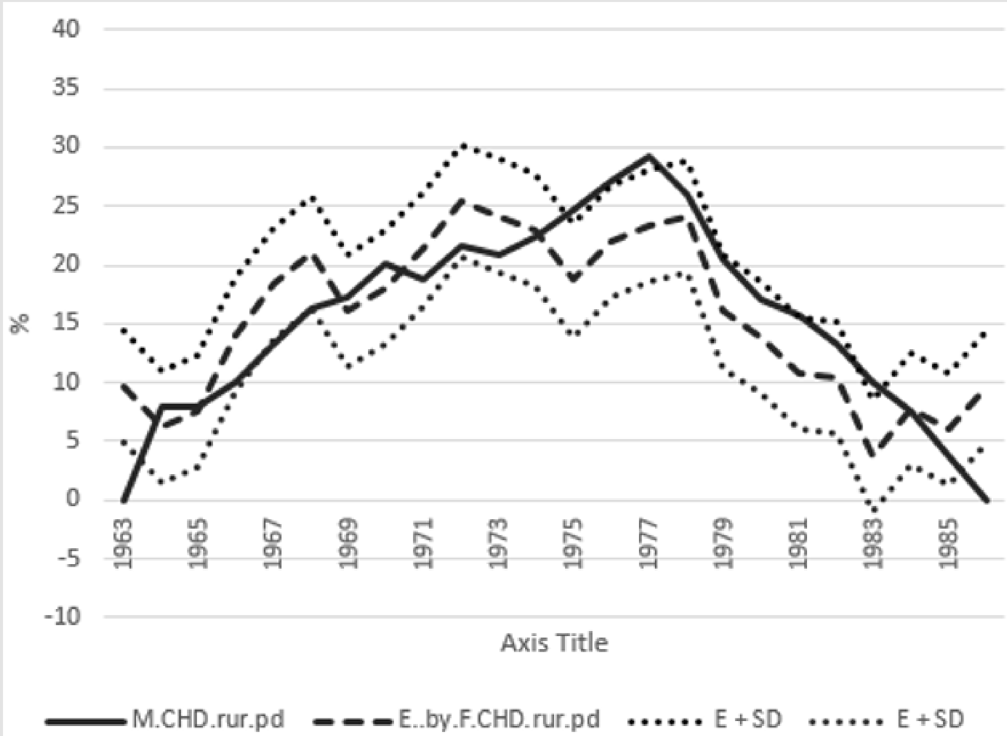

Figure 19: M.CHD.rur.3ym.pd and its regression by F.CHD.rur.3ym.pd. (R = +0.82, R square 67.7 %, p= 0.000).

Discussion

If we have only Pearson correlation coefficient (-0.32) on the association between M.CHD.rur and F.CHD.rur in 1952-77, or M.CHD.rur regression by F.CHD.rur (Figure 12) (without Fig 3), it is uncommon to guess, that they can have a plenty of similarities as is seen: CHD decrease 1952-56, continuous increase 1958-62, resistance against decrease in 1964-68 and 1964-77, but not enough to make the Pearson correlation positive. Anyhow in deviations from trendlines they showed similarities. Pearson correlation of pd data was +0.95, (F.CHD.rur.3ym.pd explained M.CHD.3ym.pd by 90.6 %) (Figure 13).

Valkonen & Martikainen have presented even annual ('orig') age-adjusted CHD mortality data of middle-aged Finnish males and females on logarithmic scale concerning period 1951-87, the first figure ("Kuvio") in [1]. The data has been measured by ruler and calculated to linear scale and adjusted by CHD data from Statistics Finland [4]. The data are ready for use in [5], here benefited only ad 1986, in order to be better comparable with Figure 8. The data have then been manufactured by pd calculator as in the Table 1.

After that is made regression analysis of M.CHD.pd by F.CHD.pd. Figure 20 shows M.CHD.pd and its regression by F.CHD.pd (R = +0.94, R square 89 %, p = 0.000). In 1952-86 regression of M.CHD.rur.3ym.pd by F.CHD.rur.3ym.pd R square was 82.6 %, which is not a surprise because of smaller population (not the whole Finland). The male-female annual compliance is surprisingly high in details. In 1975-77 is seen increase in M.CHD, not in F.CHD, invisible in M.CHD.3ym's. It has time related association with rapid reduction in smoking since 1974 [2]. Generally is known that most smokers were men. but the mortality increase was minor and this figure can exaggerate. The obvious vascular benefits of non-smoking could have been coming with delay, but then in hurry. Figures 1, 2 and 20 can arouse ideas on causal mechanisms, too, outside of the title of this article.

PubMed search by "proportional deviation from exponential trendline" gave no results.

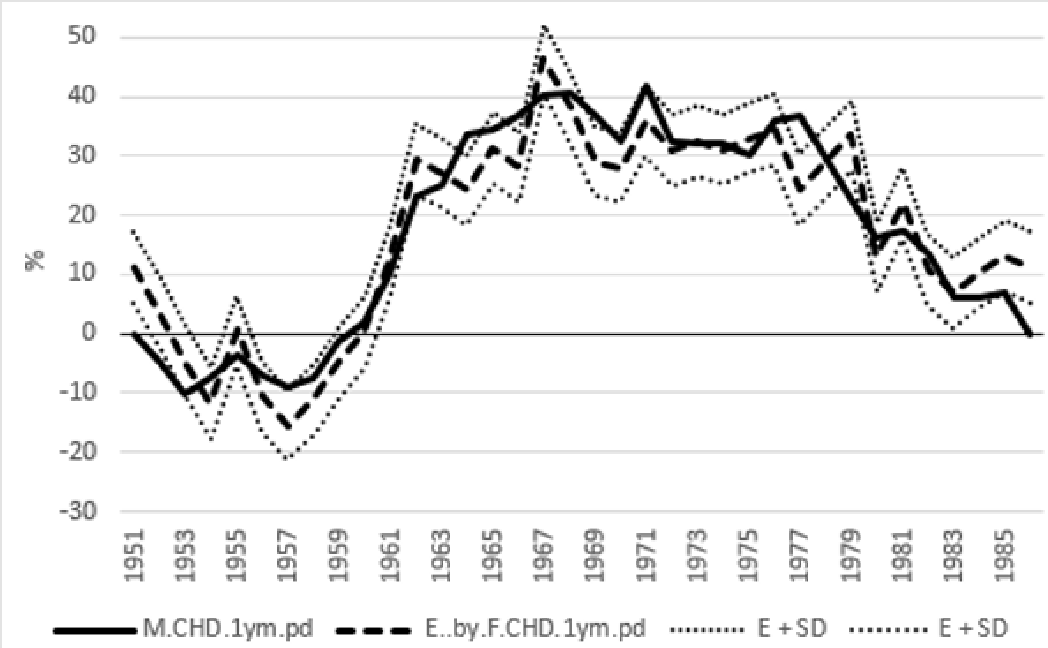

Figure 20: Regression of M.CHD.orig.pd by F.CHD.orig in 1951-86.

Summary

Pd data [based on proportional deviations from exponential trendlines between start (α) and end points (ω)], via their Pearson correlations, regressions and visual charts can give a new (?) method to evaluate similarity, especially simultaneousness in variation and possibly "pick up" some details, undetectable by linear regression analysis with native data.

PS. The pd method/experiment is resembling an earlier "7ymw-experiment", skizze, in [6]: Figure 5 presents derivative changes of (K/Mg).fm and nCHD are got via their "7 year mean weighted means" (7ymw):

$$Y_{.7ymw.i} = 1/16*\left[Y_{.(i-3)} + 2*Y_{.(i-2)} + 3*Y_{.(i-1)} + 4*Y_{.i} + 3*Y_{.(i+1)} + 2*Y_{.(i+2)} + Y_{.(i+3)}\right].$$

Derivate of

$$Y_{.i} = Y_{.7ymw.d0} = \left\{[mean\left(Y_{.(i+1)};Y_{.i}\right] - mean(Y_{.i};Y_{.(i-1)}\right\} / mean\left\{\left[mean\left(Y_{.(i+1)};Y_{.i}\right); mean\left(Y_{.i};Y_{.(i-1)}\right)\right]\right\}$$

nCHD = non-CHD = Total mortality minus CHD.

It worked in this Figure, but not in several materials. Possibly sometimes.

Acknowledgements

I am grateful to Tapani Valkonen for the permission to use his data and one postage stamp.

References

1. Valkonen T, Martikainen P (1990) Development of mortality from ischaemic heart disease in subgroups of the population in Finland. [In Finnish, with English summary] SosiaalilääketieteellinenAikakauslehti. Journal of Social Medicine 27: 273-288.
2. Töysä T (2023) Female and Male CHD Mortality in Rural and Urban Regions, Pig Map and their Associations with Behavioral and Environmental Factors, Food Processing –Association of Magnesium with CHD, Milk Fats and Whole Grain in Finland.
3. Töysä T (2023) Formation of Proportional Deviation from Exponential Trendline of Variables Increased Coherence between CHD Mortality in Different Population Groups and Strengthened in General CHD Association with Soil Mg Predictor, Based on Soil Mg Regression by Mg/Ca and Mg/K Fertilization Ratios, in Finland 1952-1986.
4. Töysä T (2018) Associations of K/Mg fertilization ratio with non-CHD mortality in Finland during 1952-99. Biomed J Sci &Tech Res 5(3).
5. Töysä T, Osmo H, Seppo H. Human CHD and Pig Cardiac Mortality in Finland during 1954-86. Biomed J Sci &Tech Res 2(4).
6. Töysä T (2018) Associations of K/Mg fertilization ratio with non-CHD mortality in Finland during 1952-99. Biomed J Sci &Tech Res 5(3).

ISSN: 2574-1241

DOI: 10.26717/BJSTR.2024.55.008663

Töysa T. Biomed J Sci & Tech Res